NEWSLETTER

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AUSTRALIAN SOCIETY FOR LIMNOLOGY
NEWSLETTER

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The Australian Society for Limnology is an association of over 200 people with professional or amateur interests relating to Australian inland waters. Since its inception in 1961, the Society has played an important role in fostering limnological work in this country. The ASL also promotes liaison between limnologists in academic, private, and governmental institutions, and has a vested interest in the conservation of aquatic and related resources. Annual congresses are held near centres of limnological interest, and the program includes scientific sessions, field excursions, and social activities.

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Newsletter contributions are always welcome, and correspondence should be addressed to the Newsletter Editor. The next copy deadline is 27 June 1975.

ARTICLES

THE BUNYIP

by Peter Costello

(A marvellous book called "In Search of Lake Monsters" by Peter Costello, has just been published by Garnstone Press, £4.25 net, London, Great Britain. Following the recent appearance of those papers by one Brian Timms on bottomless lakes it seems apposite to follow them up by an excerpt from this book. This excerpt relates to our own home-grown monster, the bunyip. The following extract is taken from that book between pages 271-276.)

"But even more mysterious are the Bunyips of Australia. The bunyip is a sort of Australian bogie, like the pooka. And like the pooka, there are some who claim to have seen it in the flesh. The word is derived from the Aboriginal, and is thought to mean something like "devil" or "spirit". To the whites it has come to mean any mysterious animal, any Boojum of the outback. Yet many accounts of these bunyips are surprisingly similar. Gilbert Whitely of the Australian Museum looked into the matter in 1939, and came up with a surprising collection of accounts, to which others have since added.

In June 1801 Charles Bailly and a party of French explorers from the Geographe, were moving up the bank of the Swan River (now above Perth). Suddenly they heard a terrible roar, louder than a bull's, coming from a bed of reeds. Thinking it was some terrible monster, they promptly fled.

Another explorer, Hamilton Hume, confirmed the existence of some such animal. He reported (in the minutes of a meeting of the Philosophical Society of Australia, in Sydney, on December 19, 1821) that in November 1821, he had seen an animal in Lake Bathurst, which was, from his account, presumed to be "the manatee or hippopotamus". The Society offered him his expenses if he would bring back a skull or skin.

He failed to do so, but reports similar to his continued to come in. E.S. Hall, who owned a farm at Bathurst, wrote in a letter to the *Sydney Gazette* (March 27, 1823), that in November 1821 he had heard and seen a strange monster, which made a noise like a porpoise and had a bulldog's head. Others had seen it as well, and he again in December 1822. The natives said it was a "devil-devil", wouldn't go near the lake and claimed the animal ate children.

A surveyor named MacBrien, it was reported in March 1823, had sighted "an animal of prodigious length" in the Fish River near Bathurst, and another had been seen elsewhere in the same river.

William Breton, an explorer, said of Lake George, "It is pretended that a species of seal, or as it is called, a devil, has been seen in it".

A newspaper in 1847 refers to the bunyip, which was called "Yaa-Loo" on the Hunter River, and also "Wowee-Wowee". It was said to have a human face, and its feet turned backwards. (This exotic detail is most revealing, as we shall see.) Reported from the Murrumbidgee River as having a head and neck like an emu, with a long flowing mane, the bunyip begins to sound more familiar. It also ate crayfish.

George Holder, of Lake Parker Station, said that some of his men had seen a bunyip in both Lake Paika and Lake Tarla.

W.H. Hovell said the Murrumbidgee natives also claimed they had seen an animal like a bullock in the lakes near the river. Natives on the Edward River called it "Tnata", though other names were also used.

By the middle of the century the bunyip was all the rage. T. Atholl Fletcher was told by natives on the Murrumbidgee that they had killed a "katenpai". He got hold of the skull and Hovell sent a drawing of it to the *Sydney Morning Herald* (February 9, 1847). The skull was examined by W.S. Macleay, who guessed that if it were a new animal, it must be placed between the horse and the llama. Then again, he added, covering his options, it might only be a deformed colt. But the English anatomist, Sir Richard Owen, to whom it was then sent, thought it was the skull of a calf. Which of them was right, or if it were a new animal, cannot now be settled: the skull has "softly and silently vanished away" in the cellar of the Australian Museum.

In 1847 Governor Latrobe obtained some native drawings of the bunyip from Victoria. But they too got lost when he sent them over to Tasmania.

A "real bunyip" turned up in the Port Fairy District of Victoria in 1848. Witnesses said it was brown in colour with a long neck and shaggy mane, and a head like a kangaroo. They also claimed it had strange powers of attracting its victims over the water.

Stocqueler, a naturalist who sailed down the Murray River in 1857 in a canvas boat, saw and drew "freshwater seals". They had two pairs of fins, or paddles, one attached to the shoulders, a long swan-like neck, a dog's head and a hairy body. They varied in length from 5 to 15 feet. When he showed his drawings to the natives, they said the animal was "the bunyip's brother".

A settler near Mount Gambier in South Australia in 1853 saw a strange animal 12 to 14 feet long in a lagoon near his station. In 1872 a shepherd saw another such aquatic animal at Midgion Lagoon near Narrandera in New South Wales. Also in 1872 a strange animal was seen in Lake Corongamile (sic), Victoria, where it so terrified one man he over-turned his punt. A Mr. D'Arcy said it was "an animal like a big retriever dog, with a round head and hardly any ears". Another was seen by many people in Lake Burrumbert near Ballarat.

In a lagoon near Narrandera in 1873 a *wee-waa* which several people saw was also said to resemble a retriever, only it was much smaller and covered in black shiny hair. The same year an animal with a seal's head appeared near Dalby in Queensland; it also had a tail with two fins. Then in 1876 yet another hairy bunyip was seen in Crystal Brooke in South Australia. A reward was offered for it, £50 dead or alive, but no-one captured it. More reports from the reservoir at Malmesbury, Wagga Wagga, and other places in

Victoria, all sound strangely like some sort of seal.

The moalgewanke of Lake Alexandria was described by the Reverend George Taplin in 1879 as some kind of weird merman with a red wig. The tunatapan of Port Philip, however, recalls the more familiar long-necked animals. "It was as big as a bullock, with an emu's head and neck, a horse's mane and tail, and seal's flippers, which laid turtles eggs in a platypus nest, and ate blackfellows when it tired of a crayfish diet".

A rider fording the River Monoglo in 1886 saw an animal "whitish in colour and about the size of a large dog". It's face recalled a child's, yet he threw stones at it to drive it away.

Until 1929 a truly fabulous bunyip with two heads which could swim two ways, haunted Tuckerbil swamp near Leeton.

But in 1890, more plausible reports brought a team from Melbourne Zoo to Eurora district in Victoria to hunt down a bunyip-like animal. And as late as May 1965, parties of local hunters at Mirramac Plains were searching the Nerang River, after local farmers had reported hearing strange blood-curdling roars, and seeing the water disturbed. Some thought it was a crocodile (supposedly extinct in the river), but old-timers said the bunyip had returned . . .

Reports of bunyips have also come from Tasmania. In 1852 one was seen in Lake Tiberias, which was 4 feet long, with a bulldog's head, and was covered with shaggy black hair. It was seen in shallow water so a glimpse was caught of its crooked feet.

Similar animals were reported from the Great Lake in 1863. Again they were between 3 and 4 feet long with a round bulldog head. They often splashed water 6 to 10 feet in the air, which reminds one of the antics of the Loch Ness Monster. They were also seen in Lake Echo. And shortly afterwards strange animals with round heads and dark flippers were seen in the Jordan River.

Between 1860 and 1870 there were numerous reports of them. In 1863 a witness observed one for a while and said it was a sort of sheepdog with two little fins, like small wings, moving at the fast speed of 30 miles an hour. Even the transformation of the Great Lake for a hydro-electric scheme did not drive them away, as they reappeared in 1932.

Gilbert Whitely concluded that "apart from the most extravagant fabrications, we must be struck with the comparative uniformity of bunyip descriptions over a long period". Usually it is said to be a furry animal, quite large, the size of a dog often and with a dog-like head. It has fins for swimming; and lives in rivers, marshes and inland lakes.

Could they be seals? Certainly they sound suspiciously like them. Seals and sea-lions are common enough around the Australian and Tasmanian sea-coasts, where they were heavily hunted in the last century. Thought of as sea-animals, the sight of one far inland might well give a farmer a surprise. There are freshwater seals in Central Asia, in the Caspian, the Aral Sea, Lake Baikal and Lake Oron. In Canada there are isolated colonies of Common Seals in some freshwater lakes. In Australia itself, the Australian sea lion has been found six miles inland, on rare occasions it has got even further. Fur seals have been captured in the Shoalhaven, 70 miles from the sea, and in 1870 a sea-leopard was taken in the same river. At Congaro the skin of seal was kept for many years, where it had been killed in the Murrumbidgee, more than 900 miles from the sea.

So it is possible for the seals to get quite far inland. Moreover, many bunyip reports come from the drainage basins of the only really large rivers in Australia.

Some reports, however, come from places where it would be almost impossible to find a seal. So some scientists have put forward bolder theories.

The bunyip [writes Whitely again] has been thought to have been an extinct marsupial otter-like animal, rumours of whose existence have been handed down in aboriginal legends, the latter corrupted and confused with crocodiles in the north of Australia and seals in the south.

This sounds very like the waitoreke legends in New Zealand. But as Bernard Heuvelmans points out, the reports speak of the bunyip as a living animal not a ghost. In the weird world of the Australian marsupials, there are equivalents of most placentary mammals, except the truly aerial or truly aquatic. If it exists, the bunyip would fill the aquatic gap.

But does this explain all the bunyip reports? There is the bunyip reported in 1847 from the Murrumbidgee, with the head and neck of an emu and a long flowing mane. The real bunyip from the Port Fairy district was brown, with a shaggy mane, long neck and a head like a kangaroo. And then there are Stocqueler's "long-necked seals" seen on the Murray River in 1857. All of these sound more like our long-necked lake monsters than true seals or marsupial otters. However, where seals could go, doubtless long-necked sea-serpents - of which there are several reports from South Australian coasts - could also go. But the latest report is from 1857, so it would seem that this particular bunyip is no longer around."

THE PURARI RIVER HYDROELECTRIC POWER SCHEME (PAPUA NEW GUINEA)

by Tomi Petr

Department of Zoology

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The proposal to construct a hydroelectric power dam on the Purari River in the Gulf District of Papua New Guinea has provoked discussions both in the press and in the Government. At present the United Nations Development Programme and the United Nations Environmental Protection Agency have been requested to sponsor an environmental feasibility study which would investigate the possible impact of this scheme on the environment in three habitats: tropical forest, river delta, and the adjacent sea.

At present, lack of basic information makes it very difficult to make predictions of what may happen if such a scheme is implemented. Some basic data relevant to the environment are collated in Table 1. The finalisation of these data depends on many factors, especially on numerous detailed observations, registration of various parameters, and calculations resulting from these. It is the task of the Engineering and Environmental feasibility

studies (the first has already started) to provide this information in time so that the final decision on the building of the Wabo Dam may be made in 1977 or in 1978.

Table 1

Wabo Lake

Dam site: 145° 05'E longitude; 6° 59'S latitude

River Purari catchment: 33670 km²
143° 22' and 146° 03'E longitude
5° 35' and 7° 56'S latitude

Rainfall: Goroka (1570 m a.s.l.) 1936 mm
Wabo dam site (61 m a.s.l.) 8630 mm
Baimuru (5 m a.s.l.) 3255 mm

Altitude of the base of the dam: 61 m a.s.l.

Dam height: 145 m

Construction material: earth filled dam

Lake: surface area at maximum level: 260 km²
length: 20 km
maximum volume: 14 km², 14 billion m³
active storage (= active capacity): 6 km³, 25 m drawdown
rate of filling and retention time: 136 days
volume: year = 3 : 1
sedimentation: 4 km³/100 years
continuous discharge 1525 m³/ sec (2040 m³/sec for 93% of time)

Proposed installation 1,800 MW, 6 units

Output: 1330 MW

6 steel penstocks 8.6 to 9.4 m in diameters

Length of penstocks: 330 m

Intake at 120 m (i.e. at 181 m a.s.l.)

The Wabo Dam site is situated about 230 river kilometres from the Coral Sea, at 61 m a.s.l. A detailed contour map has yet to be made of the area. With installation on 1800 MW, production of the Wabo Dam is anticipated to be 1330 MW (the present total production of Papua New Guinea power stations is slightly more than 100 MW). This is considerably more than that currently produced by the Akosombo Dam (833 MW in 1971) on the Volta River in Ghana, which produces some of the cheapest electric power in the world. The Wabo Lake, named after a tributary entering the Purari River at the future dam site, will be only 260 square km in area (maximum retention level), compared with the 8482 sq km of the Volta Lake. The small volume of the Wabo Lake, a maximum of 14 cubic kilometres, (*cf.* with Volta: 165 cubic km) will result in considerable drawdown, which may take place within a short period of time. The maximum drawdown is expected to reach 25 m. Kainji (River Niger), one of the large African man-made lakes, has a 12 m drawdown, and this interferes with the breeding of such fish as tilapias and possibly other species as well.

The fast drawdown in Wabo means poor prospects for a good fish population. The fish in the Purari are known to be mostly of marine origin, and probably many species require brackish or marine water for certain periods of their life history. Very little is known about this, and collection of information on the distribution and ecology of the Purari River fish is being carried out by Fisheries Research at Kanudi. There are some factors which would act against the development of fisheries in Wabo Lake. Apart from the anticipated rate of drawdown, which will prevent the development of littoral, speed up the erosion, and make breeding impossible for the majority of fish in the lake, other factors should be considered when thinking about future fisheries. The removal of timber may not be an economical proposition. However, a partial cutting of the dense tropical forest may be considered, with the rest of the vegetation being flooded by rising water in the lake. This flooded vegetation is known to have a favourable effect on fish by providing substrate for their food organisms such as algae and invertebrates, but on the other hand it prevents the use of mechanised fishing and impedes setting of gill nets. A fact speaking strongly against the development of fisheries in Wabo is the presently barely touched fish stock in the delta and the adjacent sea. Harvesting of fish and also invertebrates such as crabs, shrimps, prawns, and scallops could be intensified with less expense than that required for maintaining a fishable stock in a lake such as Wabo. At present, the Wabo area is inhabited by about 300 people, and it could only be hoped that the inflow of workers to the dam site would provide additional people with fishing interest and experience. At present the Gulf District is underpopulated, with 5 people per square kilometre, and there is strong emigration of the Gulf population, especially young people leaving for more "attractive" parts of Papua New Guinea such as Bougainville and Port Moresby.

The Purari Development Scheme, which includes future plans for the utilization of hydroelectric power by a complex of industries with heavy electricity demand, such as: aluminium smelting, processing ferro-alloys, production of nickel, copper, zinc, caustic soda, liquified gas, cement, and uranium enrichment, is opposed by traditionalists, but also by conservation groups. They believe that Wabo is too big and they fear the destruction of the natural habitat. Some of the industries will certainly result in pollution, especially by heavy metals. This may affect not only inland waters, such as rivers, but also the brackish coastal waters and the sea itself. It can be expected that some organisms may be adversely affected by this pollution. (As a matter of interest, at present some of the fish in the Fly River have such high mercury contents that they are considered a health hazard. This mercury is of natural origin and nothing can be done about it.) The Wabo Lake will also function as a sediment trap, and this may result in bringing out of balance the delicate (?) equilibrium between the input of sediments to the delta and the erosion of it by sea currents. The high turbidity of water in the river and delta may also be of importance for the aquatic organisms, but it remains to be studied in what respect.

All the above, and many other environmental factors require careful consideration before the building of the dam starts.

Finally, it should be mentioned, that within the Purari River catchment the Wabo Scheme is only one out of 10 dam sites proposed for development for hydroelectric power. The Purari River Basin has the largest potential for hydroelectric development in Papua New Guinea with the total production possibly exceeding 10,000 MW (the Snowy Mountains and Kiewa Schemes have installation for 4,000 MW, but the actual production is lower than that). In Papua and New Guinea there are two other rivers which attract the engineers: Kikori River Basin, with maximum potential of about 8,000 MW, and Strickland River Basin with more than 2,000 MW. Both of them may be considered for hydroelectric power development at a later stage. If the opposition to the

Purari-Wabo Scheme is too strong, it is possible that another site will be selected within the Purari Basin, perhaps outside the Gulf district. This would result in the Gulf District remaining the poorest in materialistic terms in Papua New Guinea.

SOME PROBLEMS FOR AUSTRALIAN LIMNOLOGISTS

by Bill Williams

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(1973 ASL PRESIDENTIAL ADDRESS)

After twelve years in Australia, there is one fact for which I have a solid memory trace. It is how little we yet know about matters limnological here. This has been reinforced in recent years by an involvement in some activities which have entailed extensive reviews of the Australian limnological literature (Williams, 1967, 1968, in press, and Bayly and Williams, 1973). I have thought it apposite, as a Presidential address, to capitalize on this involvement by attempting to focus attention on some limnological problems that to me at least seem worthy of attention here.

For present purposes, the problems to be considered can most conveniently be discussed under three headings: ecological *sensu lato*, systematic, and biogeographical. It is emphasised that in the discussion which follows, there is a restriction to subjects of mostly regional interest, and no entrance to that vast territory of limnological *terra incognita* which has no geographical boundaries will be attempted. This of course is not to say that general problems are not as worthy of study here as they are elsewhere; but my awareness of them is no better than that of many colleagues here, and I certainly occupy no special position in regard to them. Even within the Australian context some subjects will specifically not be discussed in detail, principally those which cluster around the description "fisheries".

ECOLOGICAL PROBLEMS

For convenience, ecological problems may be grouped into four major categories: those relating to particular sorts of locality or habitat; those relating to specific groups of freshwater organisms; chemical problems; and applied problems. They are perhaps best dealt with *seriatim*.

1. Problems relating to particular sorts of locality or habitat

It goes almost without saying that basic ecological data for almost any sort of Australian inland aquatic environment are extremely sparse. However, there are some environments which pose special problems within an Australian context and brief mention may be made of some of these.

Lotic habitats, running waters, may be mentioned first. The remark has been made elsewhere, but is worth repeating here, that although Australia is the world's most arid inhabited continent, for the amount of work that has been published on the ecology of Australian rivers and streams, limnologists outside Australia could well be forgiven for thinking that no running waters exist here at all! Even the one major river system that Australia does possess, the Murray-Darling, the fourth longest river system in the world, has scarcely been looked at ecologically. And perhaps those limnologists in the South Australian reaches, the so-called lavatory end, would prefer not to look too closely, anyway!

It may be emphasised that any ecological study of running waters here will provide no mere repetition of results gained elsewhere. That will be ensured by the chemical distinctiveness of Australian rivers and streams, the more or less profound differences in their flow régimes *vis-a-vis* those that have been studied elsewhere (many of our rivers and streams are more subject to seasonal and secular fluctuations in discharge rates), and the unique composition of the rheophilous fauna, if not flora. With regard to the fauna, some of the more obvious features may be noted briefly:

(1) the presence of a quite distinctive and different stonefly fauna, namely the families Eustheniidae, Gripopterygidae, and Austroperlidae, all of which are absent from the northern hemisphere;

(2) the absence of several important northern hemisphere ephemeropteran families, and the dominant presence of the Leptophlebiidae, which in Australia has undergone adaptive radiation to produce species that occupy niches elsewhere occupied by quite different families;

(3) similarly, the absence of some common northern hemisphere trichopteran families, and the adaptive radiation of some families that occur in Australia, e.g. the Leptoceridae;

(4) the abundance in lowland rivers and streams of atyid or palaemonid shrimps;

(5) the complete absence of asellid isopods which elsewhere frequently represent an important faunal component of running waters;

(6) the occurrence of phreatoicid isopods - unknown in the northern hemisphere except for India;

and many others.

A special problem for Australian stream ecologists is posed by the non-deciduous nature of Australian upland forests. Recent work has indicated that streams derive a substantial if not major part of the energy required to maintain their fauna from sources outside the stream itself, that is from allochthonous sources. Autumnal terrestrial leaf-fall is thought to be a principal source of this nature in temperate northern hemisphere region (Hynes, 1970). In Australia, the effect of the absence of a well-defined seasonal pattern of leaf-fall upon such stream features as energy budgets, species diversity and life-cycles remains largely unexplored. Some early results suggest -but no more than that - that species diversity is depressed, and invertebrate life cycles are less precisely timed.

Another regional problem for stream and river ecologists relates to the applicability of generalized longitudinal zonational patterns, and in particular that of the one proposed by Illies (1961) and said to be applicable to lotic environments worldwide. Is it possible (or perhaps better, useful, in an intellectual sense) directly to apply to Australian running waters the concepts of rhithron, potamon and the several subdivisions of these zones? Irrespective of the applicability of Illies' scheme, there is no longitudinal zonational study of an Australian river.

Let me turn now to standing water bodies. With regard to lakes, one regional problem of considerable interest concerns the degree to which benthic communities here fit onto the general scheme of results elaborated largely from lakes in Palaearctic regions. For example, how far do the Chironomidae of Australian lakes correspond to the generalized scheme elaborated by Thienemann (1920), Lenz (1925, 1927), Lundbeck (1926, 1936), Brundin (1949, 1956) and others for the association of lake types and benthic chironomids? That is, are our oligotrophic lakes characterized by *Orthocladius* and *Tanytarsus*, our mesotrophic lakes by *Stictochironomus* and *Sergentia*, and our eutrophic ones by *Chironomus bathyphilus* and *C. plumosus*? Brundin (1958) believed the scheme applicable to southern hemisphere lakes on the basis of some work he had undertaken in South America. But some early and as yet unpublished results by Brian Timms indicates that this classical concept of lake typology based on chironomid faunas scarcely applies here. Moreover, his results indicate that benthic diversity as a whole is less in Australia than expected.

Smaller bodies of standing water, i.e. ponds, farm dams, rainpools and so on, have as yet scarcely been looked at in Australia despite the many interesting regional problems they pose. This is surprising when the ubiquity of farm dams and rainpools in particular is considered. Indeed, with regard to rainpools, in a recent attempt to provide a faunal list for an Australian temporary rainpool (surely the most ubiquitous and accessible of aquatic habitats here), it was found necessary to "synthesise" one from the records of groups known to occur in such localities. No fully comprehensive listing of animals actually collected from a specific locality could be found. Apart from the viewpoint of fish-farming, the study of small bodies of permanent water never seems to have attracted the serious attention of limnologists, either here or elsewhere, in the way lakes have. Nevertheless, it is surprising that so little attention has been accorded them in Australia, where man-made ones at least are so characteristic a landscape feature in settled areas, as anyone knows who has flown from A to B in Australia. May I suggest that the ubiquity of farm dams, and their accessibility, nature and size, make them admirable study objects at a variety of intellectual levels.

A somewhat different class of regional problems, more biogeographical and strictly zoological in emphasis than ecological, is provided by Australian underground waters. Although such waters have so far hardly been looked at, they promise to yield extremely interesting and exciting information. This applies to both interstitial subsurface waters and the waters of cave systems. Concerning the former, a brief recent investigation by a visiting limnologist (Dr. H.K. Schminke from the University of Kiel) yielded with little effort the first records from Australia of the Bathynellacea, and from the Australian mainland, the first record of anaspid-like syncarids. Concerning cave faunas, it may be recalled that a completely new order of the Crustacea, the Spelaeogriphacea, was found not so long ago in a South African cave. The Gondwanaland connections of South Africa and Australia will surely provide

sufficient incentive for investigations of this sort. Likewise, the outstanding zoogeographical significance of much of the interstitial fauna provides incentives for interstitial studies.

One further sort of subsurface aquatic habitat may finally be mentioned: waters associated with "terrestrial" crayfish burrows. Already the few brief investigations of them have yielded new forms of great zoological interest, e.g. *Allanaspides* (Syncarida) with its fenestra dorsalis, an apparently unique physiological organ within the Crustacea (Swain, Wilson, Hickman and Ong, 1970).

Closely associated with underground waters are those surface waters loosely referred to as springs. One sort of spring which provides natural, permanent, freshwater localities over large areas of the arid inland of Australia is the mound spring, that is to say a spring rimmed by a large deposit of travertine or tufa which projects well above the surrounding landscape and encloses a more or less still body of water. To my knowledge, such springs are not nearly so well-developed in desert regions elsewhere as are they in Australia. In any event, we know next to nothing of their biota. Other sorts of spring in Australia, non-thermal or thermal, are likewise ill-known biologically despite the fact that much of Australia is underlain by aquifers - including the Great Australian Artesian Basin, said to be the world's largest artesian basin.

Finally in this brief resume of problems associated with particular sorts of locality or habitat, passing reference may be made to those generated by inland salt lakes. Whilst lakes of this type are certainly not confined to Australia, it seems that only here do there exist groups of them which are readily accessible to study, span the whole spectrum of salinity, are homogeneous in chemical composition, and range from ephemeral to permanent in seasonal persistence. The occurrence of these groups, combined with the many special reasons why salt lakes are attractive to ecologists studying ecosystems *in toto* (Williams, 1972), has drawn a reasonable amount of attention from those of us who are (or were) at Monash. Even so, there remains amongst them sufficient exploration for several lifetimes. Problems that are currently being studied revolve around ecosystem energetics and description, the applicability of macroscopic parameters (*sensu* Margalef, 1968) to ecosystems, and ionic and osmoregulatory phenomena.

2. Problems relating to specific groups of organisms

Turning now to a consideration of the ecology of specific groups of organisms, it must at the outset be said that little is known about the ecology of most groups of organisms living in Australian inland waters. There are exceptions, of course, but they are indeed exceptions. This general state of affairs is applicable both to organisms which are not of particular regional interest, such as the protozoans, rotifers and so on, and to those which are of much higher regional interest, such as the parastacid crayfish, syncarids, phreatoicids, mecopterans, leptophlebiids and many other invertebrate groups. It may be noted in passing that groups of high regional interest are increasingly being studied by overseas visitors; the ecology of our stoneflies has recently been studied by Hynes from Canada, and in part that of our blepharocerids and psephenids by Zwick from Germany.

The ecology of most of our native fish, likewise, is poorly known, as need hardly be said to those of you from fisheries departments, and those who have read John Lake's recent book (Lake, 1971). We know little, for example, about the feeding habits of the smaller species; we do not even know, so far as I can gather, whether we have any obligate planktivorous fish

such as occur overseas. Somewhat paradoxically, the ecology of introduced freshwater fish is much better known (e.g. Weatherley and Lake, 1967; Lake, 1971; Weatherley, 1972, in press), although this knowledge includes little which relates to the interaction of native and introduced fish and with regard to this interaction is other than circumstantial in nature. The atypical composition of our native freshwater fish fauna which, unlike the fish fauna of any other continent, is remarkably lacking in primary and secondary freshwater forms, is mostly endemic, and is of very low diversity (<170 spp., according to Lake, 1971), provides special local reasons for studying interactions of this sort.

Due mainly to the work of Bayly, Timms, Hussainy and a few others, perhaps the one Australian group of aquatic animals about which most is known ecologically is the planktonic Crustacea of standing water bodies. However, even within that assemblage, some important ecological features await clarification. Thus, seasonal events in several of the component groups require further study. For example, *Daphnia carinata*, one of the commonest of Australian cladocerans, has extreme cyclomorphic forms and is remarkably variable as a species. Yet the full seasonal cycle of morphological and geographical changes still awaits documentation (Bayly and Williams, 1973). Much further work is also needed to elucidate fully the trophic relationships within Australian zooplanktonic communities. In this connection it may be recalled that the calanoid copepods of Australian inland waters are predominantly members of the Centropagidae, whereas in the northern hemisphere they are mostly in the Diaptomidae. These families are not closely related; indeed, as Hutchinson (1967: 122) notes, they "are particularly far apart".

The phytoplankton of Australian waters *a priori* would seem to offer fewer regional problems of interest, but in any event has been little studied. One regional problem, however, which might bear investigation is the extent to which Hutchinson's (1967) recent provisional classification of phytoplankton associations applies in Australia. It appears that at least some associations here do fit his typology, although others appear not to. Thus the diatoms *Cyclotella* and *Asterionella* occur together in oligotrophic Lake Sorrell in Tasmania, yet in Europe *Cyclotella* is usually a dominant in oligotrophic waters and *Asterionella* in eutrophic ones. A serious attempt to apply to Australian lake phytoplankton the various "phytoplankton indices" elaborated in the northern hemisphere might also be not without interest.

3. Chemical problems

One central chemical problem of great regional interest concerns the sources of the salts in our inland waters. A good deal of evidence is available which suggests that a substantial proportion of such salts is derived ultimately from marine sources, either primarily or secondarily; that is, so-called cyclic salts are an important source. However, the evidence is mainly circumstantial, and though I accept it, I do not doubt that more careful and direct evidence is needed. In any event, the criticisms of those who disagree with the cyclic salt hypothesis (e.g. Wofner and Twidale, 1967; Currey, 1970) need to be considered and answered more carefully than they appear to have been. And if cyclic salts are as important here as they appear to be, why are they not of such significance on other continents?

Another chemical problem concerns the amounts of plant nutrients in Australian inland waters. On the basis of the very few data so far available (e.g. Williams and Wan, 1972), it appears that many south-eastern lakes, at least, have higher values of phosphates and nitrates than expected. Thus, in 30 Victorian lakes and reservoirs of salinity <1%, the mean spring

concentration of phosphate was 0.22 mg l^{-1}, a value greater than the mean value in seven very rich lowland lakes in Britain, 0.083 mg l^{-1} (Gorham, 1957), and certainly greater than those values which if exceeded, it is claimed, will result in eutrophication. Are plant nutrient concentrations really as high in Australian inland waters as the preliminary data suggest, and if they are, why are they? As a corollary, a further question might be: are phosphates and nitrates so important as limiting factors in Australian lakes as they are thought to be in many lakes outside Australia?

There is of course a whole galaxy of questions which relate to regional hydrochemistry. Of these, no mention will be made here other than to note that for many of the more inaccessible Australian lakes we know nothing of their water chemistry apart from the fact that the water is potable, brackish or salty!

4. Applied problems

Apart from fisheries investigations motivated primarily by management criteria, relatively few applied limnological investigations are being undertaken in Australia. The reasons need not concern us, but it should be noted that they certainly do not include an absence of applied problems. The situation is exacerbated by the distinctive character of the Australian aquatic biota and its environment. As a result, a good deal of applied limnological work undertaken elsewhere is only partly if at all applicable in Australia. For example, the large amount of European and North American work on the biological assessment of river pollution (as opposed to chemical and bacteriological assessments) is not directly applicable here. Since we do not have a fully comprehensive ecological description of an unpolluted stream we can scarcely begin to use stream biotas as biological indicators of pollution. We need firstly to know more about the taxonomy and ecology of the biota of unpolluted streams, and then to examine the way pollution of various sorts exerts an effect. It is only after that, that we shall be in a position to reverse the procedure and ask how much stream biotas can tell us about stream conditions. There is a long path ahead.

Similar reservations exist about the applicability to Australian lakes of overseas work on eutrophication. The problematical subject of plant nutrient concentrations in Australian waters has already been mentioned; an even broader subject concerns the extent to which the whole concept of eutrophication and the criteria used to define it apply in Australia. Not surprisingly, a recent project formulation panel of the Australian Water Resources Council in deciding upon priorities for an investigation of eutrophication phenomena in Australia came to the unequivocal conclusion that the first priority should be to investigate to what extent eutrophication was a problem in Australia, and if so how.

Reference was made earlier to our lack of knowledge of interactions between native and introduced fish. Our knowledge of the extent to which introduced fish interact with and affect other aquatic biota, and the environment in general, is equally poor. This poverty of knowledge will no doubt usually be of no great environmental consequence - using the term environment in its currently popular sense - , but it is possible to see that this may not always be so. The question of the environmental effect of *Cyprinus carpio* springs to mind as an example. We know little of a precise nature concerning the effect of this fish on the biota and environment of Australian lakes and rivers. Even what is known is subject to debate. Butcher (1962) maintains that the species causes great physical disturbance to aquatic habitats because of its behaviour during feeding which causes increased turbidity as a first result; Weatherley and Lake (1967), on the

other hand, doubt that its behaviour in this way is important in Australian rivers which are naturally turbid anyway.

Other exotic biota whose introduction may have important economic implications but which, so far as I can gather, are being little studied here against the total limnological background include several plant species. In particular, the water hyacinth, *Eichhornia crassipes*, and the water fern, *Salvinia auriculata*, may be mentioned. Both are natives of tropical South America; both outside that continent are frequently highly pestiferous; both occur in Australia. They should certainly be considered as potential pests in tropical impoundments such as the Ord.

Regional problems of an applied limnological nature are many and diverse. It seems invidious to select any more for discussion.

SYSTEMATIC PROBLEMS

I now need to move on rapidly to consider those problems of a systematic nature. Because time is short, the best way of doing this briefly is by means of a table (Table 1). As the table is self-explanatory, I need only comment here that, firstly, there is a very wide scope indeed for those members of the Society who have taxonomic inclinations, and, secondly, that no group can be considered as having been completely worked out, so to speak, in a taxonomic sense.

BIOGEOGRAPHICAL PROBLEMS

Australia has always been of considerable interest to biogeographers. During the past few years this interest has greatly increased because of two main reasons. Firstly, because of our revised ideas about and in general an acceptance of the theory of continental drift. And secondly, because of the application of more rigour to the study of phylogenetic relationships. I refer here to Hennig's (1950, *et seq.*) ideas on phylogentic systematics which, whilst not fully accepted by systematists and biogeographers, have certainly injected new life into biogeography. Additionally, in the past few years there has developed an increasing awareness of the zoogeographical value of certain groups of animals, a value previously underestimated or ignored. Amongst such groups many freshwater forms figure prominently. They include especially those which (a) have limited abilities of dispersal, and, amongst insects, limited powers of flight, (b) have a limited resistance to desiccation, (c) inhabit subsurface or discrete surface waters, particularly in the cooler and more temperate regions, and (d) exhibit distributional patterns mostly confined to areas within the southern hemisphere.

With regard to specific groups of this nature, attention may be drawn to some which, *a priori*, appear to be especially valuable, and which, with few exceptions, remain poorly investigated in a biogeographic sense: the amphipods, phreatoicid isopods, janirid isopods, parastacid crayfish, stoneflies, turbellarians, oligochaetes, syncarids, calanoids, certain chironomids, blepharocerids, branchiurans, and certain ostracods. Of these, only certain chironomids and syncarids (bathynellaceans) have been examined closely (Brundin, 1966; Schminke, 1971). The results, if nothing else, indicate the value of the vast corpus of information awaiting release.

It is appropriate to conclude this address by a quote from Brundin's paper on austral distributions (1967: 166-7): "There is thus still immense work to be done, not least in the area of basic field studies. Indeed, critical biogeographic research is still in its infancy, but the vastly important virgin biotopes of the southern lands disappear very rapidly as a consequence of human agency. I end this paper stressing that we are short of time and may not have many decades left in which to do what is needed for a successful approach to the fascinating problems of southern hemisphere biogeography".

ACKNOWLEDGEMENT

Several of the problems referred to in the ecological section were first emphasised by Dr. I.A.E. Bayly in his joint publication with the author. Dr. Bayly is thanked for allowing me to draw freely on his ideas.

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TABLE 1 (following page)

EXTENT OF SYSTEMATIC INVESTIGATIONS OF AUSTRALIAN AQUATIC FAUNA

* I, Groups on which some work has been published, although this is largely fragmentary in nature. Further taxonomic studies greatly needed.

II, Groups for which a reasonable amount of published work is available that provides a basic taxonomic framework. Considerable systematic work remains.

III, Groups that have been monographed or have been the subject of several studies. Nevertheless, much systematic work remains for most.

( ) = category placing derived from unpublished as well as published work.

	Intensity of Investigation*		
	I	II	III
Groups of minor regional significance (few endemic species)			
Protozoa		+	
Coelenterata	+		
Nemertea	+		
Nematoda	+		
Nematomorpha	+		
Rotifera		+	
Gastrotricha	+		
Polyzoa		+	
Tardigrada	+		
Notostraca			+
Cyclopoida		+	
Collembola	+		
Groups of major regional significance (many endemic species)			
Porifera			+
Temnocephaloidea		+	
Turbellaria	+		
Bivalvia			+
Gastropoda			+
Polychaeta		+	
Oligochaeta		+	
Hirudinea		+	
Hydracarina		+	
Anostraca			(+)
Cladocera		+	
Ostracoda		+	
Conchostraca		+	
Calanoida			+
Harpacticoida	+		
Branchiura	+		
Syncarida		+	
Isopoda		+	
Amphipoda		+	
Atyidae + Palaemonidae			+
Parastacidae + Hymenosomatidae			+
Plecoptera			(+)
Ephemeroptera		+	
Odonata			+
Corixidae			(+)
Notonectidae			+
Other Hemiptera		+	
Megaloptera			+
Neuroptera + Mecoptera		+	
Blepharoceridae			(+)
Tipulidae			+
Culicidae			+
Chironomidae		+	
Other Ciptera		+	+
Hymenoptera + Lepidoptera	+		
Trichoptera		+	+
Gyrinidae			+
Psephenidae		(+)	
Other Coleoptera		+	+
Fish			(+)
Reptilia		+	
Amphibia			+

THE BARCOO GRUNTER - REDISCOVERED

by John R. Merrick and John Barker

(School of Biological Sciences, University of Sydney)

A number of Australian freshwater perches are commonly called grunters because of their habit of croaking or grunting when taken from the water. Knowledge of the whole group (family Theraponidae) is incomplete, particularly the species frequenting the Lake Eyre Basin. One of these, *Therapon (Scotrum) barcoo* was described by McCulloch and Waite in 1917 from a single specimen; this preserved specimen now lives in the South Australian Museum.

Although good sport for anglers the animal is not good eating - the consistency of boot leather has been reported. These poor table qualities plus its occurrence in remote areas have no doubt contributed to the situation where no further work had been done on the animal until late 1974.

In November the authors mounted a small expedition from Sydney to capture a series of *Scortum barcoo* and bring some back alive. In the limited time available it was decided not to sample the Barcoo River or Cooper's Creek where the beast was known to occur. The most promising new area was the Bulloo River.

After surviving a heat-wave whilst driving up through Bourke, Cunnamulla and Thargomindah an intensive sampling programme was initiated on the upper Bulloo. After two days during which every collecting technique - except rotenone and dynamite - was employed, not a sign of a theraponid had appeared; all the other species previously recorded were captured. The authors admitted defeat and retired to the public bar at Thargomindah; the locals still swore that the three theraponid species they had identified occurring in the Bulloo included "the spotted fella". They have been subsequently proved correct.

The patrons decided collectively that if "the boys" couldn't find anything in the Bulloo then the best sure-fire spot was Nockatunga Waterhole on the Wilson River - some 80 miles further west.

Following the ample directions and instructions the scientists drove off into the west; after getting lost for a few hours they turned up at Nockatunga Homestead near the waterhole. The boss was very obliging and our discussion included a new theory he has about Nockatunga being the centre of the world. Broken Hill marks the boundary in one direction, Cunnamulla in the other; to proceed beyond these points is to run the grave risk of "falling off". For those interested in the history of Australian bushranging we were told authoritatively that "Ned Kelly wouldn't 'ave made a choir boy out 'ere".

Sampling on the Wilson continued for several days. The main problems encountered were:

- dust storms
- the 6-inch-long centipedes scuttling through the camp at night
- thousands of bony bream - the bane of Australian freshwaters. Several nets took 5 hours to clear because of large numbers of this fish.
- two juvenile crows. These characters has a whole landscape with many trees to choose from; they selected the branch above our tent

on which to noisily greet each new day (at 5.15 a.m.?!!)

However, despite the above-listed tribulations success was ours. Some 20 specimens of the Barcoo Grunter were obtained plus extensive series of two other theraponids and some unusual catfishes.

After a small emergency with the aeration on the way back to Thargomindah everything went swimmingly. On entering the Thargomindah public bar the first question (from all sides) was; "Well, didja get 'em?" When success was announced satisfaction was expressed by all present.

The preserved, frozen and live specimens returned to Sydney are now forming the basis of a detailed investigation of this species; part of a broad study on the Taxonomy and Biology of Theraponidae being conducted by John Merrick.

J.M. needs fresh specimens of all theraponids (perches or grunters) in order to make alizarin and dry skeletal preparations.

If you can provide him with material contact him at:

School of Biological Sciences,
Carslaw Building F07,
University of Sydney,
Sydney, N.S.W. 2006.

Or telephone 692-1122, Ext. 2175

All contributions gratefully received.

CONFERENCE ANNOUNCEMENT

The Eighth International Conference of the International Association on Water Pollution Research (IAWPR) will be held in Sydney from 17-22 October 1976. Further details will be given in later issues, but for those interested at this stage:

IAWPR Secretariat,
G.P.O. Box 2609,
SYDNEY, N.S.W. 2001.

CSIRO JOURNALS

You may be interested to see the following statistics, taken from the 1974 Annual Report of the Board of Standards for Australian Journals of Scientific Research. They tell their own story.

Summary of statistics for 1974-1973-1972

Australian Journal of	Pages published	Papers published	Rejected papers	Lapsed papers
Agricultural Research	991 - 952-1129	94 - 89-105	28- 33- 21	11- 6- 5
Biological Sciences	686 -1444-1383	73 -143-137	18- 30- 24	4- 7- 3
Botany	1512[a]- 316- 643	50[a]- 22- 29	8- 12- 7	5- 1- 2
Chemistry	2714 -2739-2741	330[b]-326-328	92- 57- 86	5-17-10
Marine and Freshwater Research	441 - 306- 163	32[c]- 19- 14	8- 7- 4	1- 2- 1
Physics	938[d]-1126- 976	86[d]- 89- 79	32- 20- 23	6- 6-11
Plant Physiology	594 - -	55[e]-	15- 4-	1- -
Soil Research	178 - 220- 214	19[f]- 20- 17	7- 4- 6	14- 1- 2
Zoology	1626[g]-1072-1373	51[g]- 44- 42	8- 8- 7	2- 4- 7
TOTAL	9680 -8175-8622	790 -752-751	216-174-178	49-44-41

[a]Includes 1 Supplement, 667 pages (1, 57 in 1973; 3, 293 in 1972).

[b]Includes 95 Short Communications (91 in 1973; 95 in 1972).

[c]Includes 1 Short Communication (1 in 1973).

[d]Includes 11 Short Communications (15 in 1973; 10 in 1972) and 2 Supplements, 99 pages (5, 222 in 1973; 5, 199 in 1972).

[e]Includes 5 Short Communications.

[f]Includes 2 Short Communications.

[g]Includes 11 Supplements, 1051 pages (5, 478 in 1973; 10, 909 in 1972).

LIFE IN AN IVORY TOWER

A VICE-CHANCELLOR

Leaps tall buildings in a single bound,
is more powerful than a locomotive,
is faster than a speeding bullet,
walks on water,
gives policy to God.

A HEAD OF DEPARTMENT

Leaps short buildings in a single bound,
is more powerful than a shunting engine,
is just as fast as a speeding bullet,
walks on water if the sea is calm,
talks with God.

A PROFESSOR

Leaps short buildings with a running start and favourable wind,
is almost as powerful as a shunting engine,
is faster than a speeding bullet,
walks on water in an indoor swimming pool,
talks with God if special request is approved.

A READER OR SENIOR LECTURER

Barely clears a prefabricated hut,
loses a tug of war with a locomotive,
can fire a speeding bullet,
swims well,
is occasionally addressed by God.

A LECTURER

Makes high marks on the wall when trying to clear tall buildings,
is run over by locomotives,
can sometimes handle a gun without injuring himself,
dog paddles,
talks to animals.

A GRADUATE STUDENT

Runs into buildings,
recognises locomotives two times out of three,
is not issued ammunition,
can stay afloat in life jacket,
talks to walls.

AN UNDERGRADUATE

Falls over doorstep when trying to enter buildings,
says look at the choo-choo,
wets himself with a water pistol,
plays in mud puddles,
mumbles to himself.

A DEPARTMENTAL SECRETARY

Lifts buildings and walks under them,
kicks locomotives off the tracks,
catches speeding bullets in teeth and eats them,
freezes water with a single glance,
she is God.

JOHN LAKE

A number of us have been concerned about the fate of John following the aftermath of Cyclone Tracy. I daresay that I was not alone in wondering how he and his family had fared and a bit concerned to discover his present whereabouts. I have good news: he is alive and well and in the Northern Rivers College of Advanced Education, P.O. 157, Lismore, N.S.W. Although he and his family are safe the whole of his library (including copies of his own book) were lost in the cyclone. Clearly John would appreciate any spare books, reprints and other documentation that you may have to give him, but of course is far too polite a gentleman to write to the A.S.L. Newsletter Editor with a request of that sort. So I am doing it for him!

WATER QUALITY MEETING

The Water Management Group of the Division of Irrigation Research, C.S.I.R.O., convened a meeting in Griffith, New South Wales, on March 18. The purpose of the meeting was to bring together, so far as was possible, people and organisations working in the field of water quality. Basically it was felt that there was a need for such a meeting in view of the fragmented organisation of water quality research in Australia. The meeting was informal and a broad range of topics was discussed. In the interests of open discussion and the exchange of ideas no formal minutes of the meeting were kept. Those organisations represented included the following: State Pollution Control Commission, Sydney; State Fisheries, New South Wales; W.C. & I.C.; Cities Commission, Wodonga; Health Commission, New South Wales; Department of the Environment and Conservation, A.C.T.; C.S.I.R.O. Division of Plant Industry; C.S.I.R.O. Division of Land Use Research; State Rivers and Water Supply Commission, Victoria; University of Adelaide; Caulfield Institute of Technology. The principal personalities behind the calling of the meeting were Dr. Kathy Bowmer, Dr. Emmett O'Loughlin and Dr. Barie Steer.

CONGRATULATIONS

Our congratulations to Ian Bayly (Zoology, Monash), who recently was awarded a Doctorate of Science by Monash.

SOME NEWS OF ADELAIDE

As was indicated in the previous issue of the Newsletter, Adelaide has recently been inundated with more than the normal quota of limnologists. The purpose of this article is to indicate more precisely the interests and research activities of these people. The story began some two years ago when Bill Williams, in a fit of unwarranted depression, decided to apply for a position outside Monash. He was eventually appointed to the Chair of Zoology at the University of Adelaide. Part of the attractiveness of Adelaide for Bill was that there was an expression of interest in limnology as a field which was of perhaps more than the normal importance to this State.

Bill took up the position of Chairman in January 1975 and was joined at the same time by Keith Walker and Mick Geddes, both on the lecturing staff. Shortly before, there arrived from Canada John Bishop and in early March there arrived Rod Buckney from Tasmania. In addition to these personnel, Richard Marchant, a Ph.D. student of Bill's at Monash, transferred across and there are four Honours graduates working on freshwater topics and two M.Sc. candidates similarly engaged.

Bill Williams

The major interests of Bill are in the taxonomy and ecology of certain freshwater malacostracans, particularly the amphipods and atyid prawns. Bill's interest in these animals is being supported by a grant from the Australian Biological Resources Study which enables him to employ a graduate research assistant, Dr. Meredith Smith. At the moment the study if about half complete; in England the basic redescription of known forms was more or less completed (mostly a redescription of G.W. Smith's species from Tasmania). In addition, Bill maintains an interest in salt lake ecosystems and is in the process of drawing together a review upon the subject. A book for the Australian New Naturalist series (Collins), whose title remains as yet undecided but will inevitably include the words lakes, rivers and Australia, is also being prepared. It need hardly be said that at this stage a not inconsiderable proportion of Bill's time is also spent on matters of no real consequence!

Keith Walker

Keith still maintains an active interest in the River Murray, between the areas of Lakes Hume and Mulwala (in association with Peter Tyler, Terry Hillman, Roger Croome and Bill Williams). He has plans to extend this study downstream but these are at the moment indefinite. Mound springs are a subject too, which intrigue Keith and will for part of his on-going research programme. Needless to say, salt lake ecosystems also have some attraction for Keith and I dare-day that we may expect some papers to emerge from his fluent pen in the future upon such a topic. Editorial matters, teaching committments (like the preparation of lectures for the first time after five years' lapse), not to mention a new city, a new house and a child, also occupy Keith's mental energies.

Michael Geddes

Mick Geddes has an interest which spans something more of the salinity regime than is spanned by Keith and Bill; he is interested not only in inland saline localities but also in estuarine localities. Recently he has developed an interest in the hyper-saline areas on the Coorong and in estuaries near to Adelaide. Like Keith, teaching, house buying and other inconsequential matters also occupy his time.

John Bishop

John Bishop will be unknown in a personal sense to many Australian limnologists. He is a Canadian who worked with H.B.N. Hynes in Waterloo for a time then went off to Malaysia to do a Ph.D. with Furtado. After that he returned to Canada to work with the Department of the Environment. He is in Adelaide as a Senior Teaching Fellow. His research interests are predictably with streams and in particular with those of a temporary nature. He claims that the River Murray belongs to him and is unbelievably fit and healthy. Those who wish to know more of his academic background should refer to his recently published and very large book in the Monographiae Biologicae series.

Rod Buckney

Rod comes to Adelaide fresh from the Kingdom of Tyler. He has recently completed his Ph.D., concerned with the chemistry of inland waters in Tasmania. In Adelaide he is working with Bill on a project funded by the Australian Water Resources Council entitled "Nutrient, major ion and heavy metal budgets and factors controlling their distribution within selected aquatic ecosystems". Like all chemists he seems unable to function without expensive apparatus. He is currently writing up in paper form the results of his thesis endeavours. It will take some time for him to rid himself of the pervasive influence of Tyler.

Richard Marchant

Richard Marchant is a Ph.D. student of Bill's. He transferred from Monash where his Ph.D. project was concerned with the energetics of *Parartemia*. He will continue this project with South Australian populations and has a year or so to complete this.

Margaret Brock

Margaret Brock is a tutor in the Zoology Department at Adelaide but despite being attached to such a department is really a botanist at heart, or claims to be. She is doing an M.Sc. with Bill which will be concerned with the ecology of halophytes, that is, the ecology of macrophytes associated with inland salt waters.

Joan Juniper

Joan Juniper is a recent acquisition to the Zoology Department. She too, is undertaking an M.Sc. and present indications are this will be concerned with the ecology of the aquatic bug *Ranatra*. Like Margaret Brock, very attractive and unmarried!

Honours students

Brad Mitchell, Peter Gent, Martin Caon and Nick Cotterill are Honours students and are working with Mick Geddes, John Bishop or Keith Walker. Their topics of investigation include a study of the way in which such parameters as diversity, communities and other ecological parameters change in a series of salt pans of increasing salinity.

BUCKNEY'S BELIEVE IT OR NOT

* Atmospheric salt from the sea would coat the average outdoor Tasmanian with a layer of salt 5 μm in thickness in only one year.

* Dissolved material leaving the Derwent catchment in one year amounts to a 15 μm layer of rock from the whole catchment. This does not include suspended material, so the maximum estimate of the life of the Tasmanian limnology empire is only 40 million years - even allowing for frequent retreats to higher ground.

PROFILE

Dr. John Bishop is among the recent arrivals at the Department of Zoology, University of Adelaide, where he has taken up a post as Senior Teaching Fellow. Although born in England, John has spent most of his life in Canada, and considers himself a Canadian in all respects. His B.Sc. Hons. degree was completed in 1965 at McMaster University, Hamilton. In 1968 he was awarded an M.Sc. by the University of Waterloo, Ontario, for a thesis entitled "Movements of the invertebrate fauna in a stream ecosystem". This work was carried out under the supervision of Professor H.B.N. Hynes. The abstract is as follows:

> The phenomenon of benthic invertebrate drift, common to all lotic systems was investigated qualitatively and quantitatively in the Speed River, Ontario. Incident light, the dominant exogenous factor controlling the extent and cyclicity of drift, was examined experimentally in a model stream ecosystem and activity threshold intensities determined. The significance of these was related to seasonal/temporal conditions in the natural habitat. Compensating upstream movements of immature invertebrates were monitored using specially designed apparatuses; in addition, a selective radioactive tracer (^{32}P) technique with potential use for this purpose was also developed. The population dynamics of the benthos with respect to passive and voluntary movements were analysed and the significance of these invertebrate activities both in the life histories of particular species and in the availability of food for the fish population were discussed.

John's Ph.D. work was with Dr. J.J. Furtado at the University of Malaya. His thesis was concerned with the limnology of Sungai Gombak, a small Malayan river. This work has been published in book form by W. Junk, The Hague, in the *Monographiae Biologicae* series. The thesis abstract:

> The objective of this study was twofold: first, no comprehensive lotic limnology had been done in the Malayan region prior to this work so the characterization of the ecosystem in as much detail as possible was desirable; second, the river system selected for study, the Sg. Gombak, presented an opportunity to investigate the modifications imposed on a tropical river by a succession of anthropic activities from casual forest-product collecting, logging, small-holding and plantation cultivation, to rice-growing and alluvial tin mining, to urban-industrial riparian development. The drainage basin was subdivided on the basis of morphometry and land use and the basic hydrologic parameters of precipitation, discharge, substrate composition and sediment loading were monitored for each section. A regular program of hydrochemical analyses for major

anions and cations, trace elements, dissolved gases and organic load was instituted at a series of stations. An attempt was made to correlate the observed changes in water quality with lithology and soil variations and with the progressive increase downstream in agricultural and domestic effluent input. The structure and composition of the floral and faunal communities were determined at intervals along the river and a preliminary quantitative assessment of standing stocks and production rates was made. Changes and anomalies in diversity and density were rationalized against the substrate, channel structure and physicochemical modifications imposed on the river system by activities in the watershed. A brief survey was carried out on the local fishery and its impact on the fish stocks of the river. Downstream drift of living and dead organic matter, of both endogenous and exogenous origin, was studied both as a source of fish food as energy loss from the site of production. An attempt was made to correlate the recorded upstream and downstream insect flights with drift and the "colonization cycle" concept.

In this study, some biological aspects could be handled only at a preliminary descriptive level because of the lack of taxonomic and ecological data, most notably on the insect. However, in total, this did not detract from the assessment of the impact of watershed use and abuse on the river system and its utility as a resource. A number of recommendations were made in regard to the methods of future development in the drainage basin and to pollution abatement.

Following his Ph.D., awarded in 1971, John returned to Canada to work with the Department of the Environment in Ottawa. Here he was employed both in a consultive capacity and as an original researcher concerned with the effects of man on inland waters (particularly thermal and salt pollution).

In Adelaide John will devote his time to lotic limnology of local streams and the River Murray.

Publications

Bishop, J.E. (1968). An ecological study of the branchiobdellid commensals (Annelida-Branchiobdellidae) of some mid-western Ontario crayfish. *Can. J. Zool.* 46: 835-843.

Bishop, J.E. and Bishop, J.B. (1968). A technique for selectively marking aquatic insects with ^{32}p. *Limnol. Oceanogr.* 13: 722-724.

Bishop, J.E. and Hynes, H.B.N. (1969). Upstream movements of the benthic invertebrates in the Speed River, Ontario. *J. Fish. Res. Bd. Canada* 26: 279-298.

Bishop, J.E. and Hynes, H.B.N. (1969). Downstream drift of the invertebrate fauna in a stream ecosystem. *Arch. Hydrobiol.* 66: 56-90.

Bishop, J.E. (1969). Light control of aquatic insect activity and drift. *Ecology* 50: 371-380.

Bishop, J.E. (1973). Limnology of a small Malayan river. *Monographiae Biologicae* 22: 1-485.

Bishop, J.E. (1973). Observations on the vertical distribution of the benthos in a Malaysian stream. *Freshwater Biol.* 3: 147-156.

JOINT ASL - NZLS CONGRESS?

Please be sure to study the questionnaire interleaved with this issue, relating to a possible joint meeting with our New Zealand colleagues in 1976. If a joint congress is to be held, it may affect the timing of the regular ASL meeting (although it certainly will not displace it). More details later.

EXECUTIVE COMMITTEE MINUTES

20 NOVEMBER 1974, Arthur Rylah Inst., Victoria

1. Present — J. Powling (President)
D. Buckmaster (Sec/Treasurer)
S. McCallum, D.F. McMichael, K. Shearer, I.D. Hiscock

2. Apologies — Apologies were received from all absent members of Committee.

3. Business arising

(a) Bulletin costs — The Sec/Treasurer reported that publication costs for Bulletin No. 5 totalled $1,227.63.

(b) Directory — Sec/Treasurer reported that, due to a number of factors, he would not be able to compile the Directory until Feb. 1975. He undertook to have this job completed before the next A.G.M.

(c) Bookplate — The President reported that Mr. Tilzey would have the bookplate design ready "in the near future".

(d) Payments to East-West Airlines — Sec/Treasurer reported that all matters related to charter air fares had now been resolved, and that payment had been made.

(e) Importation of goldfish — It was agreed that, since this question was being discussed at the Australian and State Government levels, it seemed that the Society should not proceed further until the outcome of current negotiations was known.

4. Correspondence — All items received were tabled and noted. Several matters required further attention:-

(i) A request from Dr. W.D. Williams that the Executive Committee should consider regular revision of the Jolly Award Selection Committee.

(ii) A report from Dr. J. Martin on the results of the questionnaire on disposition of holotypes. It was agreed that the Society had no mandate to continue the matter further, and that the results should be published in Newsletter after further consultation with Dr. Martin.

(iii) A letter from Dr. C. Burns (New Zealand), in which it was suggested that a joint meeting be held in New Zealand in May 1976. Dr. Burns indicated that she hoped to be able to attend the 1975 Congress in Canberra.

5. Accounts for payment — Expenditure was authorised for payment of the following accounts:-

D.F. McMichael	Deposit on boat hire	$ 50.00
H. Clarke & Co.	Printing of brochure	136.21
East-West Airlines	Charter air fares	4185.00
C.S.I.R.O.	Refund on air fares	57.00
Novaprint	Purchase of Newsletter paper	93.00
Murray's Coaches	Deposit for buses	100.00

6. Society's Financial Situation — The Sec/Treasurer gave details of the Society's current financial situation, in relation to funds available for publication of Bulletin No. 6.

7. General Business

(a) Bulletin — Dr. Hiscock reported that he now had sufficient material available to justify publication of Bulletin No. 6. The Committee agreed that Dr. Hiscock should proceed, provided that the total publication cost did not exceed $1,500.00.

The Committee considered a report from Dr. Walker, in which he suggested that the Bulletin might be discontinued and replaced by a series of "occasional publications".

It was agreed that the question of the future of the Bulletin should be resolved at the next A.G.M.

(b) Newsletter — The Committee noted that Dr. Walker would not be able to handle publication of Newsletter next year, and resolved that abstracts of papers for the 1975 Congress should not be printed in Newsletter.

8. Congress & A.G.M. — The date and venue was confirmed:-

- 9-12th May, 1975
- A.N.U., Canberra

9. Next Meeting — To be decided at a later date.

D.E. Buckmaster,
Hon. Secretary/Treasurer.